The opinion in support of the decision being entered today was not written for publication and is not binding precedent of the Board.

Paper No. 18

# UNITED STATES PATENT AND TRADEMARK OFFICE

## BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Ex parte IRA B. GOLDBERG et al.

Appeal No. 2003-0275
Application No. 09/550,032

ON BRIEF

Before COHEN, FRANKFORT, and NASE, Administrative Patent Judges.
NASE, Administrative Patent Judge.

DECISION ON APPEAL

This is a decision on appeal from the examiner's final rejection (Paper No. 6, mailed August 24, 2001) of claims 1 to 25, 30 and 31, which are all of the claims pending in this application.[1]

We REVERSE.

[1] Claims 20, 22 and 24 were amended subsequent to the final rejection.

## BACKGROUND

The appellants' invention relates to a drive unit assembly using an electromagnetic retarding system on an axle to produce a retarding force that works with a vehicle braking system to slow and stop the vehicle (specification, p. 1). A copy of the claims under appeal is set forth in the appendix to the appellants' brief.

The prior art references of record relied upon by the examiner in rejecting the appealed claims are:

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| Fisher et al. (Fisher) | 5,212,419 | May 18, 1993 |
| Bodie et al. (Bodie) | 5,707,115 | Jan. 13, 1998 |
| Boberg | 6,155,365 | Dec. 5, 2000 |

Claims 1 to 10 and 15 to 19 stand rejected under 35 U.S.C. § 103 as being unpatentable over Bodie in view of Fisher.

Claims 11 to 14 stand rejected under 35 U.S.C. § 103 as being unpatentable over Bodie in view of Fisher and Boberg.

Claims 10 to 25, 30 and 31 stand rejected under 35 U.S.C. § 103 as being unpatentable over Boberg in view of Fisher.

Rather than reiterate the conflicting viewpoints advanced by the examiner and the appellants regarding the above-noted rejections, we make reference to the answer (Paper No. 13, mailed April 9, 2002) for the examiner's complete reasoning in support of the rejections, and to the brief (Paper No. 12, filed February 11, 2002) and reply brief (Paper No. 14, filed June 17, 2002) for the appellants' arguments thereagainst.[2]

## OPINION

In reaching our decision in this appeal, we have given careful consideration to the appellants' specification and claims, to the applied prior art references, and to the respective positions articulated by the appellants and the examiner. Upon evaluation of all the evidence before us, it is our conclusion that the evidence adduced by the examiner is insufficient to establish a prima facie case of obviousness with respect to the claims under appeal. Accordingly, we will not sustain the examiner's rejections of claims 1 to 25, 30 and 31 under 35 U.S.C. § 103. Our reasoning for this determination follows.

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[2] Since the rejection of claims 20 to 24 under 35 U.S.C. § 112, second paragraph, set forth in the final rejection was not set forth in the examiner's answer we assume that this ground of rejection has been withdrawn by the examiner. See Ex parte Emm, 118 USPQ 180, 181 (Bd. App. 1957).

**The claimed subject matter**

Claims 1, 11, 15, 20 and 25, the independent claims on appeal, read as follows:

1. A vehicle drive unit assembly comprising:
a drive axle extending between a pair of wheels and including an axle shaft for driving said wheels;
a braking system including a brake member supported on each of said wheels and an actuator for selectively moving said brake members between an unactuated position and an actuated position, said braking system for producing a braking force to slow the rotation of said wheels when said brake members are in said actuated position; and
a retarding system including at least one magnet mounted to said axle shaft for rotation with said axle shaft and an inductor held fixed independently from said magnet, said retarding system for producing a retarding force as said magnet rotates with respect to said inductor to slow the rotation of said wheels when said actuator moves said brake members to the actuated position.

11. A vehicle comprising:
an engine;
an axle having a housing extending between a pair of wheels and including an axle shaft rotatably supported with respect to said housing for driving said wheels;
a driveshaft extending between said engine and said axle, said driveshaft for providing input to said axle shaft to drive said vehicle wheels;
a braking system including a first brake member supported on one of said wheels, a second brake member supported on the other of said wheels, and an actuator for selectively moving said first and second brake members between an unactuated position and an actuated position, said braking system for producing a braking force to slow the rotation of said wheels when said first and second brake members are in said actuated position; and
a retarding system including at least one magnet supported for rotation with said axle shaft anal an inductor mounted to said housing, said retarding system for producing a retarding force as said magnet rotates with respect to said inductor to slow the rotation of said wheels when said actuator moves said first and second brake members to the actuated position.

15. A method for simultaneously retarding the speed of a vehicle and regenerating operating power for a vehicle system comprising the steps of

a) providing a drive axle powered by an engine and including an axle housing extending between a pair of wheels with a rotating member for driving the wheels;

b) generating a braking force to slow rotation of the wheels;

c) generating a magnetic field between the rotating member and the axle housing during braking to produce a retarding force to additionally slow rotation of the wheels; and

d) storing energy generated by the magnetic field in an accumulator.

20. A vehicle drive unit assembly comprising:

a driveshaft driven by an engine;

an axle extending between a pair of wheels and including an axle shaft coupled to said driveshaft for driving said wheels;

a retarding system having an actuated position and an unactuated position, said retarding system including at least one magnet mounted for rotation with at least one of said driveshaft or axle shaft and an inductor held fixed independently from said magnet wherein said retarding system selectively produces a retarding force as said magnet rotates with respect to said inductor to slow the rotation of said driveshaft or axle shaft when said retarding system is in said actuated position; and

a controller for moving said retarding system between said actuated and unactuated positions.

25. A vehicle drive train assembly comprising:

an engine;

an axle having a housing extending between a pair of wheels and including an axle shaft rotatably supported with respect to said housing for driving said wheels;

a driveshaft extending between said engine and said axle, said engine for providing driving input to said axle shaft via said driveshaft to drive said vehicle wheels;

a braking system including a brake member supported on each of said wheels and an actuator for selectively moving said brake members between an unactuated position and an actuated position, said braking system for producing a braking force to slow the rotation of said wheels when said brake members are in said actuated position; and

a retarding system including at least one magnet separated from an inductor to define a gap such that said magnet and inductor can move relative to one another without interference wherein said magnet is directly mounted to either one of said housing or to one of said axle shaft or driveshaft and said inductor is directly mounted to the other of said axle shaft or driveshaft or to said housing, said retarding system for producing a retarding force as said magnet and inductor move relative to one another to slow the rotation of said wheels when said actuator moves said brake members to the actuated position.

**Bodie's teachings**

Bodie's invention relates to a regenerative braking method. Referring to Figure 1, an electric vehicle comprises electric motor propulsion system 11, brake system 15 and control unit 13. The electric motor propulsion system 11 includes battery pack 10, inverter 12 (for use with AC motors), accelerator pedal 20 and electric motor and drive train 18. Brake system 15 includes brake pedal 70, hydraulic braking system 17 and electric drum brakes 48 and 50. Control unit 13 includes motor controller 22 for controlling the propulsion system 11 and brake controller 66 for controlling brake system 15.

Bodie's hydraulic brake system 17 comprises master cylinder 78, hydraulic lines 40, 42, 86, 87, 94 and 96, accumulator 92, actuators 114 and 116, solenoid valves 102 and 104, brake calipers 36 and 38 and brake discs 32 and 34. Brake controller 66 responds to operator depression of brake pedal 70, providing brake information to motor controller 22 and controlling the hydraulic brake system, including solenoid valves 102 and 104, actuators 114 and 116, and electric rear brakes 48 and 50.

The motor drive unit 18 may be a single drive motor driving both wheels 24 and 26, may be two motors connected back-to-back driving wheels 24 and 26, or may be two or more motors with each motor incorporated into each wheel assembly. Additionally, the motors may be AC motors or DC motors, including one or more brushless DC motors. The drive train preferably comprises a reduction gear set coupled to the motor output shaft and driving the vehicle drive wheels.

Bodie operating condition 2 (column 4, lines 16-64) teaches the following:

> Assume that accelerator pedal 20 is not depressed and that brake pedal 70 is depressed. When brake pedal 70 is depressed, master cylinder 78 provides hydraulic pressure in hydraulic lines 86 and 87 proportional to the amount of pressure placed on the brake pedal by the foot of the vehicle operator. A brake switch 72 provides a signal through line 76 to brake controller 66 indicating that brake pedal 70 has been depressed. In response to the signal indicating that brake pedal 70 has been depressed, solenoid valves 102 and 104 are commanded via line 120 to close, isolating hydraulic lines 94 and 96 from hydraulic lines 40 and 42. The pressure signals on lines 84 and 85 from pressure transducers 88 and 90 indicate the amount of pressure in hydraulic lines 86 and 87, which is a measure of the pressure applied to the brake pedal 70.
>
> Accumulator 92 has two expandable chambers that expand when fluid pressure on pistons 93 forces center spring 91 to compress. This allows the brake pedal to be depressed in a normal manner when more pressure is applied to the brake pedal, despite the closing of solenoid valves 102 and 104. Without accumulator 92, when solenoid valves 102 and 104 close, travel of the brake pedal 70 would be substantially halted.

> Brake controller 66 converts the brake pedal pressure signals on lines 84 and 85 to a brake torque command and provides a request on line 60 to motor controller 22 for regenerative braking. Motor controller 22 continuously runs a routine (i.e., every 100 ms) to determine the amount of regenerative braking capable by monitoring rotational speed of motor 18 and by monitoring the condition of battery pack assembly 10, including the voltage level and current flow. The amount of regenerative braking capable is determined by the amount of power that can be generated by motor 18 at its given rotational speed. The determined amount of regenerative braking capable may be limited by other factors, such as battery voltage conditions, which indicate the amount of power that can be transferred to battery pack 10 without harming the electrical system or battery pack 10, and vehicle speed.
>
> Motor controller 22 then, responsive to the brake regeneration request and the determined regeneration capability, commands power inverter 12 through line 16 to place motor 18 in a regenerative state and transfer energy to battery pack 10. The regenerative state of motor 18 provides braking torque to the vehicle wheels to which motor 18 is connected at a level corresponding to either (a) the determined regenerative braking capability, or (b) the brake torque command, whichever is less.

**Boberg's teachings**

Boberg's invention relates generally to a hybrid electric vehicle and, more particularly, to an electric motor/regenerator and friction brake torque distribution control strategy for a hybrid electric vehicle. Referring to Figure 1, a hybrid powertrain system 10 is illustrated for a motor vehicle 8. The hybrid powertrain system 10 includes a heat engine 14 operating on a hydrocarbon based or fossil fuel; a clutch mechanism 16 and a transmission 18. Transmission 18 connects to engine 14 through clutch 16 and transmits engine rotation and power at various ratios to a pair of drive wheels 26 of the motor vehicle. Transmission 18 drives a differential unit 28 which engages a pair of axle shafts 30 which are operably connected to the pair of wheels 26.

The hybrid powertrain system 10 also includes an electric motor 32 operably connected to transmission 18 at the opposite end of an input shaft from clutch 16. Electric motor 32 is connected to the input shaft opposite from clutch 16 by a gear train 33. The electric motor 30 is able to provide both positive and regenerative torque, by functioning as a motor and a generator, respectively. An example of an electric motor 32 is an induction motor or a permanent magnet motor, such as manufactured by Delphi Electronics Corporation.

As a generator, electric motor 32 produces a regenerative torque, preferably as an alternating current (A/C), which is transferred to a control mechanism, such as a motor controller 34. Motor controller 34 changes the alternating current into a direct current (D/C). The direct current may then be transmitted to an energy storage apparatus 38, such as a battery. Alternatively, as a motor, the electric motor 32 produces a positive torque that is applied to the input shaft of the transmission 18 and is ultimately used to drive wheels 26.

Motor vehicle 8 is provided with a regenerative braking system, capable of capturing kinetic energy from the momentum of the motor vehicle as it is slowing down and storing this energy as potential energy in the energy storage apparatus 38. Electric motor 32 is controlled to slow the motor vehicle down by applying a braking force that slows down the rotation of the input shaft. Electric motor 32 functions as a generator and captures the reverse energy flow. Motor vehicle 8 is also provided with a friction brake system which includes a brake controller 46 and a plurality of friction brakes assemblies 48 which apply a braking force to the wheels 26 of the vehicle 8.

**Fisher's teachings**

Fisher's invention relates to a high power-to-weight electromotive device capable of use as a motor, alternator or generator. The electromotive device utilizes stacks of oriented magnetic material as stator bars. Electrical conductors are wound about the stator bars to create a stator inductor. The stator bars are generally configured to shield the electrical conductor winding from electromagnetic forces and further, to provide a first flux return path for the magnetic flux created by magnets fixed to a rotor for movement with respect to the stator inductor.

**Ascertainment of the differences**

After the scope and content of the prior art are determined, the differences between the prior art and the claims at issue are to be ascertained. Graham v. John Deere Co., 383 U.S. 1, 17-18, 148 USPQ 459, 467 (1966).

Based on our analysis and review of Bodie and claim 1, it is our opinion that the only difference is the limitation that the retarding system include at least one magnet mounted to the axle shaft for rotation with the axle shaft and an inductor held fixed independently from the magnet, the retarding system for producing a retarding force as the magnet rotates with respect to the inductor to slow the rotation of the wheels when the actuator moves the brake members to the actuated position.

Based on our analysis and review of Bodie and claim 11, it is our opinion that the differences include (1) an axle having a housing extending between a pair of wheels and including an axle shaft rotatably supported with respect to the housing for driving the wheels; (2) a driveshaft extending between an engine and the axle for providing input to the axle shaft to drive the vehicle wheels; and (3) a retarding system including at least one magnet supported for rotation with the axle shaft anal an inductor mounted to the housing, the retarding system for producing a retarding force as the magnet rotates with respect to the inductor to slow the rotation of the wheels when the actuator moves the first and second brake members to the actuated position.

Based on our analysis and review of Bodie and claim 15, it is our opinion that the differences include (1) the step of providing a drive axle powered by an engine and including an axle housing extending between a pair of wheels with a rotating member for driving the wheels; (2) the step of generating a magnetic field between the rotating member and the axle housing during braking to produce a retarding force to additionally slow rotation of the wheels; and (3) storing energy generated by that magnetic field in an accumulator.

Based on our analysis and review of Boberg and claim 20, it is our opinion that the differences include (1) a retarding system having an actuated position and an unactuated position, the retarding system including at least one magnet mounted for rotation with at least one of the driveshaft or axle shaft and an inductor held fixed independently from the magnet wherein the retarding system selectively produces a retarding force as the magnet rotates with respect to the inductor to slow the rotation of the driveshaft or axle shaft when the retarding system is in the actuated position; and (2) a controller for moving the retarding system between the actuated and unactuated positions.

Based on our analysis and review of Boberg and claim 25, it is our opinion that the differences include (1) an axle having a housing extending between a pair of wheels and including an axle shaft rotatably supported with respect to the housing for driving the wheels; and (2) a retarding system including at least one magnet separated from an inductor to define a gap such that the magnet and inductor can move relative to one another without interference wherein the magnet is directly mounted to either one of the housing or to one of the axle shaft or driveshaft and the inductor is directly mounted to the other of the axle shaft or driveshaft or to the housing, the retarding system for producing a retarding force as the magnet and inductor move relative to one another to slow the rotation of the wheels when the actuator moves the brake members to the actuated position.

**Obviousness of claimed subject matter**

In rejecting claims under 35 U.S.C. § 103, the examiner bears the initial burden of presenting a prima facie case of obviousness. See In re Rijckaert, 9 F.3d 1531, 1532, 28 USPQ2d 1955, 1956 (Fed. Cir. 1993). A prima facie case of obviousness is established by presenting evidence that would have led one of ordinary skill in the art to combine the relevant teachings of the references to arrive at the claimed invention. See In re Fine, 837 F.2d 1071, 1074, 5 USPQ2d 1596, 1598 (Fed. Cir. 1988) and In re Lintner, 458 F.2d 1013, 1016, 173 USPQ 560, 562 (CCPA 1972).

In the rejections before us in this appeal, the examiner concluded that it would have been obvious at the time the invention was made to a person of ordinary skill in the art to have modified either Bodie's electric motor 18 or Boberg's electric motor 32 as taught by Fisher's electromotive device. Thus, Bodie's modified electric motor 18 and Boberg's modified electric motor 32 would each include a magnet rotating relative to an inductor.

The appellants argue throughout both briefs that the applied prior art does not suggest the claimed subject matter. We agree. While the examiner may be correct that it would have been obvious at the time the invention was made to a person of ordinary skill in the art to have used Fisher's electromotive device for either Bodie's electric motor 18 or Boberg's electric motor 32, such a modification of Bodie's and Boberg's system does not result in the claimed subject matter for the reasons that follow.

With regard to claim 1, the above-noted modification of Bodie does not result in a retarding system having at least one magnet mounted to the axle shaft for rotation with the axle shaft. In the modified system of Bodie the rotating magnet would be mounted on the motor shaft, not on the axle shaft as recited in claim 1.

With regard to claim 11, the above-noted modification of Bodie does not result in a retarding system having at least one magnet supported for rotation with the axle shaft. In the modified system of Bodie the rotating magnet would be supported for rotation with the motor shaft, not on the axle shaft as recited in claim 11. Moreover, in the rejection of claim 11, the examiner failed to account for the limitation that the axle has a housing extending between a pair of wheels and including an axle shaft rotatably supported with respect to the housing for driving the wheels, a limitation not taught by any of the applied prior art.

With regard to claim 15, the above-noted modification of Bodie does not result in the step of generating a magnetic field between the rotating member and the axle housing during braking to produce a retarding force. In the modified system of Bodie the step of generating a magnetic field is done between the motor shaft and the motor housing not the rotating member and the axle housing as recited in claim 1. Moreover, in the rejection of claim 15, the examiner again failed to account for the step of providing an axle housing extending between a pair of wheels, a limitation not taught by any of the applied prior art.

With regard to claim 20, the above-noted modification of Boberg does not result in a retarding system having at least one magnet mounted for rotation with at least one of the driveshaft or axle shaft. In the modified system of Boberg the rotating magnet would be mounted on the motor shaft, not on either the driveshaft (in Boberg the driveshaft would be the shaft from transmission 18 to the differential 28) or the axle shaft (Boberg's axle shafts 30) as recited in claim 20.

With regard to claim 25, the above-noted modification of Boberg does not result in a retarding system having at least one magnet directly mounted to either one of the axle housing or to one of the axle shaft or driveshaft. In the modified system of Boberg the rotating magnet would be mounted on the motor shaft, not on either the axle housing, the driveshaft (in Boberg the driveshaft would be the shaft from transmission 18 to the differential 28) or the axle shaft (Boberg's axle shafts 30) as recited in claim 20. Moreover, in the rejection of claim 25, the examiner failed to account for the limitation that the axle has a housing extending between a pair of wheels and including an axle shaft rotatably supported with respect to the housing for driving the wheels, a limitation not taught by any of the applied prior art.

For the reasons set forth above, the applied prior art does not establish a prima facie case of obviousness for the claimed subject matter. Accordingly, the decision of the examiner to reject independent claims 1, 11, 15, 20 and 25, and claims 2 to 10, 12 to 14, 16 to 19, 21 to 24, 30 and 31 dependent thereon, under 35 U.S.C. § 103 is reversed.

## CONCLUSION

To summarize, the decision of the examiner to reject claims 1 to 25, 30 and 31 under 35 U.S.C. § 103 is reversed.

REVERSED

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|---|---|---|
| IRWIN CHARLES COHEN<br>Administrative Patent Judge | ) | |
| CHARLES E. FRANKFORT<br>Administrative Patent Judge | ) | BOARD OF PATENT APPEALS AND INTERFERENCES |
| JEFFREY V. NASE<br>Administrative Patent Judge | ) | |

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